

## Claims

### What is claimed is:

1. An optical identification element attached to a chemical, comprising:
  - 5 an optical substrate;
  - at least a portion of said substrate having at least one diffraction grating disposed therein, said grating having at least one refractive index pitch superimposed at a common location;
  - 10 the grating providing an output optical signal when illuminated by an incident light signal;
  - said optical output signal being indicative of a code in said substrate; and
  - the chemical being attached to said substrate.
2. The apparatus of claim 1 wherein said substrate is made of a glass material.
  - 15 3. The apparatus of claim 1 wherein said code comprises a plurality of bits.
  4. The apparatus of claim 1 wherein the number of pitches is indicative of the number of said bits in said code.
  - 20 5. The apparatus of claim 1 wherein said substrate has a length that is less than about 500 microns.
  6. The apparatus of claim 1 wherein said substrate has a cylindrical shape.
  7. The apparatus of claim 1 wherein said grating is a blazed grating.
  - 25 8. The apparatus of claim 1 wherein said code comprises a plurality of bits, each bit having a plurality of states.
  9. The apparatus of claim 1 wherein said substrate has a reflective coating disposed thereon.

10. The apparatus of claim 1 wherein said substrate is has a magnetic or electric charge polarization.
11. The apparatus of claim 1 wherein said substrate has a grating region where said grating and a non-grating region where said grating is not located; and
- 5 wherein said substrate has a plurality of grating regions.
12. The apparatus of claim 1 wherein said substrate has geometry having holes therein.
13. The apparatus of claim 1 wherein said substrate is has a geometry having protruding sections.
- 10 14. The apparatus of claim 1 wherein at least a portion of said substrate is has an end cross sectional geometry selected from the group: circular, square, rectangular, elliptical, clam-shell, D-shaped, and polygon
- 15 15. The apparatus of claim 1 wherein at least a portion of said substrate is has a side view geometry selected from the group: circular, square, rectangular, elliptical, clam-shell, D-shaped, and polygon.
16. The apparatus of claim 1 wherein at least a portion of said substrate is has a 3-D shape selected from the group: sphere, a cube, a pyramid.
17. The apparatus of claim 1 wherein said code comprises at least a predetermined number of bits, said number being: 3, 5, 7, 9, 10, 12, 14, 16, 18, 20, 24, 20 28, 30, 40, 50, or 100.
18. A microparticle attached to a chemical comprising:  
an optical substrate;  
at least a portion of said substrate having at least one diffraction grating disposed therein, said grating having at least one refractive index pitch superimposed  
25 at a common location;  
the grating providing an output optical signal when illuminated by an incident light signal;  
said optical output signal being indicative of a code in said substrate; and  
the chemical being attached to said substrate.

19. A method of performing a multiplexed experiment, comprising:  
obtaining an optical substrate at least a portion of which having a diffraction  
grating with one or more refractive index pitches superimposed at a common location;  
attaching a chemical to said substrate;  
5 illuminating said substrate with incident light, said substrate providing an  
output light signal; and  
reading said output light signal and detecting a code therefrom.

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